STATEMENT OF WORK
FOR
Antenna Range Positioner
PR No. AC-07-00850

1.0 BACKGROUND

The Office of AML-2000, Radar Product Division's mission is to provide logistics support for all FAA ATC Radar systems as well as Radar systems within other government agencies and internationally.

The need for this requirement is to provide the equipment and project management for the turnkey, long-range antenna range refurbishment of the FAA's antenna range in Oklahoma City, Oklahoma. This antenna range is the primary repair facility responsible for the refurbishment and testing of the following National Airspace System (NAS) antennas: Air Traffic Control Radar Beacon Interrogator (ATCBI-4, -5, and -6,) Airport Surveillance Radars (ASR-7, -8, -9, and -11,) and Mode Select Beacon System (MODE-S.)

This Statement of Work describes the detailed description of the equipment and services to be provided by the contractor to complete the project requirements.

2.0 SCOPE OF WORK

The scope of this contract is to replace the existing antenna range positioners with larger capacity antenna range positioners, upgrade the antenna test program and operating computer, and integrate the new Agilent test equipment into the test range.

The contractor shall analyze the existing range equipment and test methods and propose a strategy for meeting the criteria specified in this SOW. Access to the facility for reviewing the equipment will be made available during the request for proposals period.

3.0 REQUIREMENTS

3.1 (Reserved)

3.2 Design Necessary Equipment

3.2.1 The contractor shall design and provide a replacement Azimuth (AZ)/Elevation (EL)/AZ antenna positioner with the following capabilities:

3.2.1.1 Withstand Torque for Elevation Positioner = 150,000 ft-lbs

3.2.1.2 Withstand Torque for Upper AZ Positioner = 35,000 ft-lbs

3.2.1.3 Withstand Torque for Lower AZ Positioner = 45,000 ft-lb

3.2.1.4 Nominal Speeds: Upper AZ at least .33 rpm, EL at least 25deg/min, Lower AZ at least .2rpm

3.2.1.5 Rotary Encoder/Synchro Accuracies: Upper AZ +/-.02 deg, EL +/-.02 deg, Lower AZ +/-.02 deg

3.2.1.6 Direct Encoder/Inductosyn accuracy +/-.005 deg

3.2.1.7 Maximum Backlashes: Upper AZ .04 deg, EL .03 deg, Lower AZ .03 deg

3.2.1.8 Elevation Limit-to-Limit Travel Upper AZ +/- 200 deg (360 while EL is in –35 to +110 deg sector), EL –35 to +110 deg (allowing full upper AZ travel), Lower AZ +/- 200 deg.

3.2.1.9 Mounting Height from Base to EL centerline to be the same as existing within +/- .5"

3.2.1.10 Thru hole in the upper AZ positioner

3.2.1.11 20 degree mounting wedge (See existing)

3.2.1.12 Adjustable counterweights sufficient to offset weights of antennas under test (see 3.2.1.1, 3.2.1.2, and 3.2.1.3)

3.2.1.13 OSHA compliant open-grid service platform, 1000# capacity, with handrails on lower AZ platform. This platform is to be large enough (approximately 6'Wide X 12' Long) to accomplish the mounting and dismounting of the antenna under test. (See existing)

3.2.1.14 Adjustable interlock circuit to limit the travel zone from axis-to-axis.

3.2.1.15 Base riser to accommodate 3.2.1.4 with weld mounting ring and OSHA compliant ladder. Weld mounting ring is to be no larger than 72" OD. Ladder is to be used for safely climbing from the tower deck to the service platform mentioned in 3.2.1.7.

3.2.1.16 Manual Stow Pins for upper AZ, EL, and lower AZ.

3.2.1.17 Test Fixture adapter – the upper AZ positioner must match the mounting of the existing test fixtures so that they can be directly mounted together.

3.2.2 The contractor shall provide a six-axis position control system to control the positioner in 3.2.1 complete with:

3.2.2.1 Six-Axis Sequential Position Controller. Selectable one axis at a time.

3.2.2.1.1 EMI Filtering MIL-STD-461/2, VDE 0871/3.68

3.2.2.1.2 BCD Update Rate 24Bit @61 microseconds (+/-10%)

3.2.2.1.3 Binary Update Rate 19 Bit @ 80 microseconds (+/- 10%)

3.2.2.1.4 TTL Increment Output Selectable Pulse Width selectable from 1.96 to 248 microseconds, Interval resolution .0001 deg., Max Time Jitter 10 microseconds, Max Increment Rate 4000 pulses/second

3.2.2.1.5 Data Takeoff Accuracy Dual Speed Synchro .0025deg (12 bit) .0006deg (14 bit), Single Speed Synchro .087 (12 bit) .02 (14 bit), Incremental Encoder up to 27 bit resolution

3.2.2.2 Power Control Unit with power supply unit and indoor enclosure

3.2.2.2.1 6-Axis Control Capability

3.2.2.2.2 1/8 - 5 HP motor capacity range with forward and reverse capabilities

3.2.2.2.3 Speed Control Bandwidth 2kHz

3.2.2.3 Hand Held Unit, Local Control Unit (LCU) to control the power control unit described in 3.2.2.2. It utilizes the controller's basic control, limit and supply circuits and incorporates a rotary switch for selecting one of up to six axes, coarse/fine velocity selection, limit indicators, and a potentiometer for speed/direction control.

3.2.2.4 Positioning Cable Set – All Cables to connect between the positioners and the controllers.

3.2.2.5 Interface to Existing Scientific Atlanta (SA) 59511 Field Probe.

3.2.2.6 Control Room Equipment Racks (2 ea approximately 19" X 63") with adequate capacity for new FAA-provided Agilent test Equipment and the newly provided positioner control equipment.

3.2.3 The contractor shall provide Transmit-side positioning system to support the existing low band (12') and high band (10') dish antennas:

3.2.3.1 Transmit Polarization Positioner #1

3.2.3.1.1 Transmit Squint Fixture with Vertical Load of 1,500 lbs, Bending Moment of 2,000 ft-lbs, AZ & EL travel of +/- 15 deg

3.2.3.1.2 Bending Moment of 6,000 ft-lbs

3.2.3.1.3 Operating Load of 1,000 lbs

3.2.3.1.4 Delivered Torque of 25 ft-lbs

3.2.3.1.5 Drive Power 1/3 HP

3.2.3.1.6 Maximum Speed 30 rpm

3.2.3.1.7 Accuracy +/- .25 deg

3.2.3.1.8 Maximum Backlash .2 deg

3.2.3.2 Transmit Polarization Positioner #1

3.2.3.2.1 Transmit Squint Fixture with Vertical Load of 1,500 lbs, Bending Moment of 2,000 ft-lbs, AZ & EL travel of +/- 15 deg

3.2.3.2.2 Bending Moment of 6,000 ft-lbs

3.2.3.2.3 Operating Load of 4,000 lbs

3.2.3.2.4 Delivered Torque of 500 ft-lbs

3.2.3.2.5 Withstand Torque of 600 ft-lbs

3.2.3.2.6 Drive Power 1/3 HP

3.2.3.2.7 Maximum Speed 1.5 rpm

3.2.3.2.8 Accuracy +/- .03 deg

3.2.3.2.9 Maximum Backlash .05 deg

3.2.3.3 Six-Axis Sequential Position Controller. Selectable one axis at a time.

3.2.3.3.1 EMI Filtering MIL-STD-461/2, VDE 0871/3.68

3.2.3.3.2 BCD Update Rate 24Bit @61 microseconds (+/-10%)

3.2.3.3.3 Binary Update Rate 19 Bit @ 80 microseconds (+/- 10%)

3.2.3.3.4 TTL Increment Output Selectable Pulse Width selectable from 1.96 to 248 microseconds, Interval resolution .0001 deg., Max Time Jitter 10 microseconds, Max Increment Rate 4000 pulses/second

3.2.3.3.5 Data Takeoff Accuracy Dual Speed Synchro .0025deg (12 bit) .0006deg (14 bit), Single Speed Synchro .087 (12 bit) .02 (14 bit), Incremental Encoder up to 27 bit resolution

3.2.3.4 Hand Held Unit, Local Control Unit (LCU) to control the power control unit described in 3.4.2.2. It utilizes the controller's basic control, limit and supply circuits and incorporates a rotary switch for selecting one of up to six axes, coarse/fine velocity selection, limit indicators, and a potentiometer for speed/direction control.

3.2.3.5 Positioning Cable Set – All Cables to connect between the positioners and the controllers.

3.2.3.6 Control Room Equipment Rack (1 each approximately 19" X 63") with adequate capacity for new FAA-owned Agilent test equipment and the newly provided positioner control equipment.

3.2.4 Switch Controller. The contractor shall supply a controller which provides at least 32-bits of hardware based I/O control for time critical functions. The controller shall be capable of controlling solid-state microwave switches with TTL inputs, as well as high voltage electro-mechanical switches. In addition, the contractor shall provide and integrate a channel switching network, which will allow measurements of each test port (SUM, Delta, and Difference) within one rotation of the antenna.

3.2.5 Design Submittal: The contractor shall provide a draft of the final design to the Contracting Officer's Technical Representative (COTR) within 30 days after contract award. The COTR will provide comments/suggestions on the draft design within two weeks after receipt. The contractor shall re-submit the final design to the COTR within two weeks after receipt of the COTR's comments/suggestions.

3.2.6 Installation. The contractor shall provide the supervision, labor, tools, equipment and incidentals necessary for a complete and professional installation of the system (except heavy lifting, rigging, and tower climbing which will be accomplished by FAA personnel.)

3.3 Software Upgrades, Maintenance, and Training

3.3.1 Upgrade of existing antenna range 959 Spectrum Software to assure all detailed parts of the system function together properly. This is to be accomplished at the factory and will ensure that all of the new electronic Agilent test equipment and the hardware prescribed in this SOW will function properly together. The following is a list of the FAA-owned Agilent equipment to be provided as Government-furnished Equipment (See SIR/RFO Section G, Clause G.2):

3.3.1.1 E8362B – 10MHz – 20GHz Vector Network Analyzer
3.3.1.2 E8362B-014 – Configurable Test Set Deck
3.3.1.3 E8362B-UNL – Extended power range with bias tee
3.3.1.4 E8362A-010 – Add Time Domain capability
3.3.1.5 E8362A-080 – Frequency Offset
3.3.1.6 E8362A-081 – Reference Receiver Switch
3.3.1.7 E8362A-1CP – Rack-Mount kit for installation with handles
3.3.1.8 E8257D-520 – Frequency Range from 250kHz to 20GHz, including E8257D – PSG signal generator
3.3.1.9 E8257D-1CP – Rack-Mount Flange and front handle kit
3.3.1.10 E8257D-1E1 – Step Attenuator
3.3.1.11 83017A – Amplifier, 0.5-26.5 GHz, 25dB gain
3.3.1.12 87421A – Power Supply

3.3.2 **On-Site Enhanced Software Training** following the on-site installation, integration and test of the completed system by an experienced software engineer. Training will transfer enhanced knowledge so that the FAA personnel are able to optimize the software's configuration and settings. Training to be for two complete working days.
3.3.3 **On-site System Enhanced Level Training** following the on-site installation, integration and test of the completed system by an experienced field service or system engineer. Training will transfer enhanced knowledge so that the FAA personnel are able to optimize the software's configuration and settings. Training to be for one complete working day.
3.3.4 **Software maintenance and Support** for one year providing the latest software updates with telephone/email/fax technical support.
3.3.5 **PNA RF Subsystem Interface** – integration of an Agilent PNA network analyzer into the outdoor antenna range while maintaining compatibility with the FR959 Spectrum software. The PNA will be located in the control room rack.
3.3.6 It is the contractor's responsibility to ensure that all items are packaged properly for shipment and installed at the FAA antenna range in OKC in new condition. In the event that any/all components are damaged during shipment or installation, it is the contractor's responsibility to replace the items with new ones.

3.4 Acceptance Testing

Factory Acceptance Test (FAT) – The contractor is to test all of the components it will provide at the FAA to ensure that each one functions properly and meets all of the requirements specified in this SOW. This shall be performed on each component individually and all of the components together as a system. The following tests are required to be completed, documented, and submitted to the FAA:

3.4.1.1 Positioning Subsystem Portion
- **3.4.1.1.1** Overall QA Inspection & Workmanship\Bending Moment
- **3.4.1.1.2** Backlash
- **3.4.1.1.3** Rate Stability @ 100% & 50 % Velocity (No Load each Axis)
- **3.4.1.1.4** Maximum Velocity, No Load each axis
- **3.4.1.1.5** Absolute Angle Accuracy – Every 90 deg for each axis – No Load
- **3.4.1.1.6** Travel & Directional Control
- **3.4.1.1.7** Limit to Limit Travel
- **3.4.1.1.8** Interlock Circuit Test
- **3.4.1.1.9** Stow Lock Test
- **3.4.1.1.10** Inspection of Corrosion Protection
- **3.4.1.1.11** Electrical Continuity
- **3.4.1.1.12** Smooth Operation
- **3.4.1.1.13** Motor Current
- **3.4.1.1.14** Tachometer Output
- **3.4.1.1.15** Front Panel Controller Operation
- **3,4,1,1,16** Remote GPIB Controller
- **3.4.1.1.17** Readout Resolution
- **3.4.1.1.18** Repeatability

3.4.1.2 System Level Tests
- **3.4.1.2.1** Control RF Subsystem (with in-house PNA system)
- **3.4.1.2.2** Control Positioning Subsystem (with in-house setup)
- **3.4.1.2.3** Error Free Software Operation
- 3.4.1.2.4 Documentation Set Check

3.4.2 **Site Functional Test (SFT) of Beacon Antenna** – Contractor alongside FAA personnel shall successfully complete automatic beacon antenna test and printout data (Reference attached documents JR980905, JR980901, and ATCRBS TEST DATA). Must show that all of the current tests have been completed successfully and are printed in a usable format.

3.4.2.1 Positioning Subsystem Portion
- **3.4.2.1.1** Physical Inspection
- **3.4.2.1.2** Rate Stability @ 100% and 50% velocity with antenna mounted
- **3.4.2.1.3** Maximum Velocity with antenna mounted
- **3.4.2.1.4** Travel & Directional Control
- **3.4.2.1.5** Limit to Limit Travel
- **3.4.2.1.6** Interlock Test
- **3.4.2.1.7** Stow Lock Test
- **3.4.2.1.8** Smooth Operation
- **3.4.2.1.9** Front Panel Controller Operation
- **3.4.2.1.10** Remote (GPIB) Controller Operation

3.4.2.2 System Level Portion Test
- **3.4.2.2.1** Physical inspection of all delivered components
- **3.4.2.2.2** Overall system level functional test
- **3.4.2.2.3** Overall functional test of positioning subsystem
- **3.4.2.2.4** Control FAA's Agilent PNA RF subsystem
- **3.4.2.2.5** Control Receive Positioner System
- **3.4.2.2.6** Switch Matrix Test
- **3.4.2.2.7** Error Free Software Operation
- **3.4.2.2.8** Integration and Test of FAA RF subsystem
- **3.4.2.2.9** Comprehensive software functionality test
- **3.4.2.2.10** Run FAA tests for 8 hours (See Attachments 1 and 2)
- **3.4.2.2.11** Axis Movements, travel, and overall operation of the positioner

3.4.3 **SFT of Terminal Antenna** – Contractor alongside FAA personnel shall successfully complete automatic ASR-11 antenna test and printout data. Must show that all of the current tests have been completed successfully and are printed in a usable format.

3.4.3.1 Positioning Subsystem Portion
- **3.4.3.1.1** Physical Inspection
- **3.4.3.1.2** Rate Stability @ 100% & 50% velocity with antenna mounted
- **3.4.3.1.3** Maximum Velocity with antenna mounted
- **3.4.3.1.4** Travel & Directional Control
- **3.4.3.1.5** Limit to Limit Travel
- **3.4.3.1.6** Interlock Test
- **3.4.3.1.7** Stow Lock Test
- **3.4.3.1.8** Smooth Operation
- **3.4.3.1.9** Front Panel Controller Operation
- **3.4.3.1.10** Remote (GPIB) Controller Operation

3.4.3.2 System Level Portion Test
- **3.4.3.2.1** Physical inspection of all delivered components
- **3.4.3.2.2** Overall system level functional test
- **3.4.3.2.3** Overall functional test of positioning subsystem
- **3.4.3.2.4** Control FAA's Agilent PNA RF subsystem
- **3.4.3.2.5** Control Receive Positioner System
- **3.4.3.2.6** Switch Matrix Test
- **3.4.3.2.7** Error Free Software Operation
- **3.4.3.2.8** Integration and Test of FAA RF subsystem
- **3.4.3.2.9** Comprehensive software functionality test
- **3.4.3.2.10** Run FAA tests for 8 hours (See Attachments 3 and 4)
- **3.4.3.2.11** Axis Movements, travel, and overall operation of the positioner

3.5 Drawings and Technical Manuals

Both "as-is" and "final" component level schematic drawings are to be constructed in AutoCAD (*.dwg) or SolidWorks (*.sld*) format. All of the technical word documents are to be provided in MS-Word (*.doc) or Adobe Acrobat (*.pdf) format. Drawings and technical manuals shall be provided to the Contracting Officer's Technical Representative (COTR.) Final drawings and manuals shall be provided within 30 days of completion of installation and site testing.

3.5.1 Complete a functional schematic drawing of all of the major hardware and electronic components of the current FAA antenna range and how they function together.
3.5.2 Complete a functional schematic drawing of all of the major hardware and electronic components of the proposed FAA antenna range and how they function together.
3.5.3 Provide parts breakdown drawings complete with part numbers for all of the new components specified in this SOW.
3.5.4 Provide technical manuals for all of the new components specified in this SOW.

3.6 Documentation

All of the technical word documents are to be provided in MS-Word (*.doc) or Adobe Acrobat (*.pdf) format. Documentation shall be provided to the contracting officer and the COTR.

3.6.1 Monthly status reports for the progress of the project including percentage of each milestone completed shall be provided no later than the first calendar day of each month.
3.6.2 Contractor shall provide documentation to show that the Project Initiation and Start-Up, Initiate Planning and Start-Up, project management, final design, and vendor procurements have been completed no later than two months after award.
3.6.3 Within three months of contract award, the contractor shall provide documentation that the long lead-time items have been ordered.
3.6.4 Contractor shall provide documentation that a successful Factory Acceptance Test (FAT) (sign-off on acceptance test report FAT-R) has been accomplished no later than eleven months after contract award.
3.6.5 Documentation that the equipment has been delivered to the FAA shall be provided no later than twelve months after award.
3.6.6 No later than thirteen months after contract award, the contractor shall provide documentation that the Successful On-Site Installation and Site Functional test (SFT) (sign-off on acceptance test report – SFT-R) has been accomplished.

4.0 DELIVERABLES

TASK	DESCRIPTION	DUE DATE
1	Design and provide equipment	NLT 12 months after award
2	Software upgrade, maintenance, training and warranty	NLT 13 Months after Award
3	Acceptance Testing	NLT 13 Months after Award
4	Drawings and technical manuals	NLT 13 Months after Award
5	Documentation	NLT 13 Months after Award

5.0 KEY PERSONNEL AND QUALIFICATION REQUIREMENTS

The positions and the minimum qualifications considered necessary for performance of the work are listed below:

LABOR CATEGORY	QUALIFICATION REQUIREMENTS
Program Manager	Primary point of contact for the contractor with the FAA. Must have at least 5 years of experience in managing the design, manufacture, and installation of antenna test ranges.
Chief Scientist	Must Demonstrate at least 5 years of experience in the design and technical management of complex antenna measurement systems.
Installation Manager	Must Demonstrate at least 5 years of experience in planning and controlling the successful installation of antenna range measurement systems.
Project Engineer	Must demonstrate at least 5 years experience in the successful completion of similar antenna measurement equipment projects.

6.0 PERIOD OF PERFORMANCE

Period of Performance is effective on date of award and continues for 13 months.

7.0 HOURS OF PERFORMANCE

Support facility operations shall be maintained and be consistent with Government personnel working hours Monday through Friday unless otherwise specified. Primary hours of performance for contractor personnel, unless otherwise specified, are from **6:00am to 6:00pm**.

8.0 PLACE OF PERFORMANCE

The Contractor shall complete manufacture of components and FAT at the Contractor's premises. Installation shall occur on-site at the FAA Antenna Range in Oklahoma City, OK.

On-site Location

Federal Aviation Administration
8201 S Mac Arthur Blvd
Oklahoma City, OK 73169

ATTACHMENT 2
MMAC CONTRACTOR INJURY/ILLNESS INFORMATION

Contract Company Name: ______________________________

Contract Company 6-digit NAICS Code: ____________
(If unknown, NAICS codes can be obtained by going to: http://www.naics.com/search.htm)

FISCAL YEAR	HOURS WORKED	NUMBER OF OSHA RECORDABLE CASES*	NUMBER OF CASES WHICH RESULTED IN DAYS AWAY AND/OR RESTRICTED/TRANSFERRED DUTY

***OSHA Recordable is defined as mishaps that result in fatalities, lost workdays, medical treatment, restricted workdays, or a loss of consciousness.**

3.0 Far Field Pattern Test

RAYTHEON
SERVICE COMPANY

TEST PROCEDURE
ATCRB 5 FOOT ARRAY

P/N 2052110-1
FAA TYPE NUMBER FA-9764

para 6.5 Phase set up??? Rx Setup???

Use Data Sheets JR980906

SHEET NO.												
REV. STATUS												
SHEET NO.												
REV. STATUS												

	ISSUE:
ORIGINATOR: Joe Russum	ISSUE DATE:
REVISED BY:	ORIG. DATE:
QA APPR.:	ENGRG APPD:

1.0 Scope

This procedure is to be used to measure the ATCRB 5 Foot Array antenna patterns. The pattern data taken for this test is printed out by the Antenna Analysis software with pass/fail indications. The printed patterns shall be attached to the data sheet drawing number JR980906 and become a part of the test data. Digital data shall be stored on floppy disk and retained in the antenna test range data library. The Antenna Analysis Software will also print out a pattern test check sheet. Any patterns that do not pass the required test shall be indicated as failing on the check sheet that is printed out by the pattern analysis program. The check sheet shall be signed by the operator and attached to the data sheet.

2.0 Equipment required:
Oklahoma City Antenna Test Range (See Antenna Test Range manual)

3.0 Reference Documents, Data Sheet, Test Procedure, ATCRB 5 Foot Array JR980906

4.0 Set Up

4.1 Record the serial numbers of the antenna, dual feed assembly. (Record)

4.2 Inspect the antenna for damage, loose cables, and corrosion. If the antenna appears to be alright, proceed with the test. (Check)

4.3 Install the Array antenna on the antenna test range per Figure 1. The mixer should be as close to the antenna under test as practical, and there must be at least a 10dB pad between the mixer and the dual feed assembly. Mount the standard gain horn behind the Array. Connect the mixer to the standard gain horn.

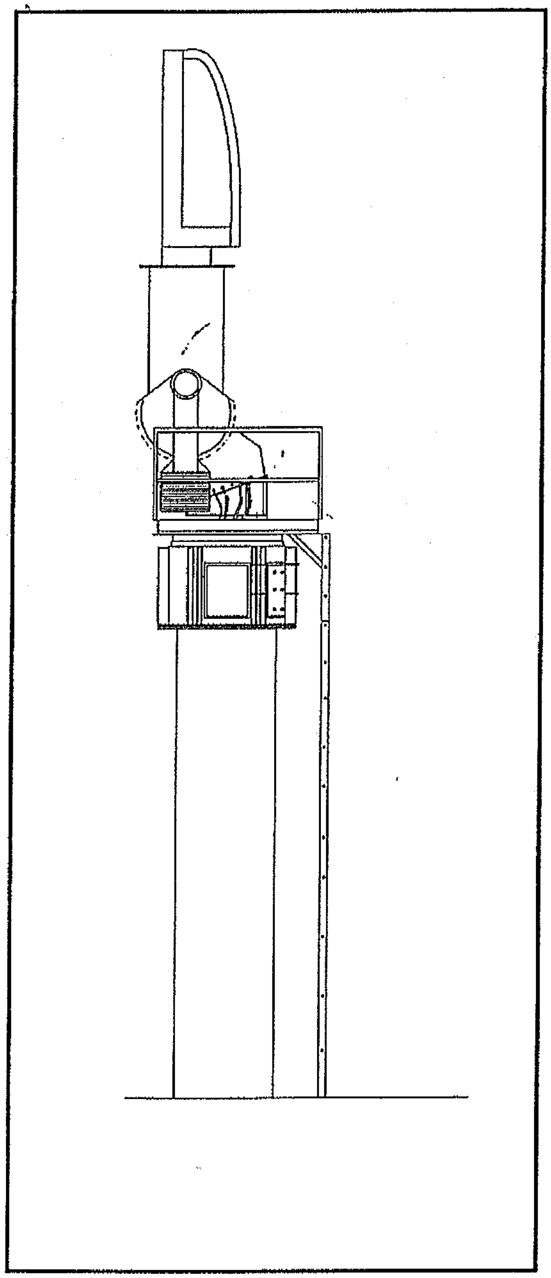

Figure 1 Test configuration for ATCRB 5 Foot Array.

4.4 Check the nominal settings of the AAP Data Acquisition System. The settings listed below are nominal settings and can be adjusted for best operation of the antenna test range:

Mixer Current	2.0ma
FR	10 MHz (Search Bandwidth)
Bandwidth	2
Band	2 (200Hz)
Averaging Sample	3
AAP Record	Mid Scale
Interval	1/3 up from bottom

(Check)

4.5 Operate the elevation pedestal until the upper azimuth axis mounting surface is parallel to the earth. With a level, verify that the array center column it is perpendicular to the earth fore and aft and side to side. If it is not perpendicular to the earth then shim the array mounting until it is. (Check)

4.6 Adjust the back fill element so it is perpendicular to the earth. (Check)

4.7 Allowance for range reflections

The allowable range reflections of -35dB for the 5 Foot Array range can cause errors in the measured sidelobe and back lobe levels. For antenna sidelobes in the range of -28dB to -35dB, the reflections can cause measurement errors of 3 to 5dB higher than actual sidelobes.

To allow for this condition, each antenna is permitted to have not more than two instances where the pattern measurements exceeds the allowable sidelobe or back lobe limit by up to 2dB. The deviations as printed on the data sheet will be circled and noted as acceptable. The number of deviations will be noted on the data sheet at the end of the test.

The current L-Band reflection of the FAA antenna test range is on the order of -17dB as opposed to the -35dB required by the array specification. As a result only principal plane patterns, patterns cut through the peak of beam, can be measured with any degree of accuracy. Higher elevation azimuth patterns should be taken, but can not be measured on the current range configuration.

4.8 Pedestal Usage

All azimuth patterns will be cut using the upper azimuth pedestal. Elevation patterns will be cut using the lower azimuth pedestal. All pedestals are required to properly position the antenna for any cut.

4.9 Frequency

Currently 1.09GHz can not be used except under special conditions because of interference problems with a nearby radar. The substitute frequency of 1.06GHz may be used until this condition is changed.

4.10 Documentation
Compute generated charts will be attached to the data sheet as part of the test documentation.

4.11 Patterns to be recorded are as follows:

Pattern Number	Pattern Name	Frequency
S3	Standard Gain	1.03GHz
S9	Standard Gain	1.09GHz
A3	Azimuth POB	1.03GHz
A9	Azimuth POB	1.09GHz
E3	Elevation	1.03GHz
E9	Elevation	1.09GHz
A3W	360 Degree Azimuth	1.03GHz
A9W	360 Degree Azimuth	1.09GHz
D9	Difference, Azimuth	1.09GHz
D9W	360 Degree Difference	1.09GHz
MSL3	36 Degree SLS	1.03GHz
MSL3W	360 Degree SLS	1.03GHz
D9P	Phase of Difference	1.09GHz
E3B	Elevation SLS Coverage	1.03GHz
DE9	Elevation Difference	1.09GHz

Note: The following patterns must be cut on the same day.

S3
S9
A3
A9
D9
MSL3

E3B

5.0 Gain Measurement

5.1 Rotate the antenna using the upper azimuth and elevation pedestals to find the peak of beam of the standard gain horn. Using the elevation pedestal cut a standard gain horn pattern from the -2dB point to the -2dB point on the other side of the POB. (Pattern S3)

5.2 Change the transmitter frequency to 1.09 and repeat paragraph 5.1. (Pattern S9)

5.3 Move the mixer to the sum port of the array.

5.4 Set the lower azimuth pedestal to 0 degrees. This angle is reached when the elevation pedestal is aligned with the range centerline in azimuth.

5.5 Using the upper azimuth (roll axis) and elevation axis, find the azimuth sum beam peak of beam and record the pedestal settings. (Record)

5.6 Back the upper azimuth pedestal 30 degrees and record a pattern from -30 degrees to +30 degrees. Run the pedestal slow enough to get several data points in each sidelobe. (Pattern A9)

5.7 Change the transmitter frequency to 1.03GHz and repeat paragraphs 5.5 and 5.6 except run the pedestal from +30 degrees to -30 degrees. Locate the azimuth peak of beam after the pattern is cut. (Record) (Pattern A3)

5.8 Run the analysis program for the following patterns:
S3
S9
A3
A9

6.0 Azimuth patterns

6.1 Back the upper pedestal to -180 degrees and cut a pattern from -180 degrees to +180 degrees. The pedestal can be run faster for this cut, but slow down the pedestal when 10 degrees on either side of the teal of beam. (Pattern A3W)

6.2 Change the frequency to 1.09GHz and cut another pattern from 180 degrees to -180 degrees. (Pattern A9W)

6.3 Move the mixer to the difference port. From -180 degrees cut a pattern to +180 degrees. (Pattern D9W)

6.4 Move the upper azimuth pedestal to +30 degrees and cut a pattern from +30 to -30 degrees. (Pattern D9)

6.5 Instruct the Acquisition software to read phase rather than amplitude.

6.6 Cut a pattern using the upper azimuth pedestal from -10 degrees to +10 degrees. (Pattern D9P)

6.5 Move the mixer from the Difference port to the SLS port. Change the frequency to 1.03GHz. Cut a pattern from -18degrees to +18 degrees using the upper azimuth pedestal. (Pattern MSL3)

6.6 Move the upper azimuth pedestal to +180 degree and cut a pattern from +180 to -180 degrees. (Pattern MSL3W)

Run the following pattern analysis:

A3W
A9W
D9
D9W
MSL3
MSL3W
D9P

7.0 Elevation Patterns

7.1 Move the mixer to the sum port.

7.2 Operate all three pedestal axis to place the array on its side so its 25 foot axis is perpendicular to the ground and the face is pointing to the source antenna. Locate the peak of beam. Record the pedestal readouts on a scratch pad.

7.3 Rotate the lower azimuth axis so a point 25 degrees above the peak of beam is pointing in the direction of the source antenna.

7.4 Operate the elevation axis to peak locate the local peak of beam. If the elevation axis synchro reading is different from the reading recorded in paragraph 7.2, then rotate the lower azimuth pedestal back to the peak of beam position of paragraph 7.2 and repeat paragraphs 7.2 through 7.4. Record the pedestal synchro axis readouts on scratch paper. Repeat this process until you do not have to change the elevation axis to reach the local peak of beam at a point 25 degrees above the peak of beam.

7.5 Using the lower azimuth pedestal cut a pattern from -45 degrees to +60 degrees. (Pattern E3)

7.6 Change the frequency to 1.09GHz and repeat paragraphs 7.2 through 7.5. (Pattern E9)

7.7 Difference and SLS beam elevation pattern.
Rotate the antenna back to the peak of beam position. Move the mixer to the difference port. Using the upper and lower azimuth pedestals, locate one of the difference pattern peak of beam. Repeat paragraphs 7.2 through 7.4.

7.8 Using the lower azimuth pedestal, cut a pattern from -10 degrees to +40 degrees. Rotate the lower azimuth pedestal back to the last peak of beam. (Pattern DE9)

7.9 Move the mixer to the SLS port. Change the frequency to 1.03GHz.

7.10 Using the upper and lower azimuth pedestals, locate one of the SLS pattern peak of beam. Repeat paragraphs 7.2 through 7.4.

7.11 Using the lower azimuth pedestal, cut a pattern from -10 degrees to +40 degrees. (Pattern E3B)

7.12 Run the following pattern analysis:
E3
E9
E3B
DE9

8.0 If the antenna passes all test and all procedures are completed, sign and date the data sheet.

PAGE 1 ATCRBS1 ANT. SR. NO. ________ DATE ________

RUN #	DESCRIPTION	30	90	CHART #	STD	READING	FAIL	REMARKS
SUM AZMITH RUM								
1	GAIN	X			21DB			
1	GAIN		X		21DB			
2	MAX S.L. SUM (AZ)	X			26DB			
4			X					
2	XPOL SUM (AZ)	X			25DB			
4			X					
3	BEAMWIDTH SUM 3DB (AZ)	X			2.1-2.6 DEG.			
5			X					
3	BEAMWIDTH SUM 10DB (AZ)	X			NOT > 4.5 DEG.			
5			X					
3	BEAMWIDTH SUM 20DB (AZ)	X			NOT > 7 DEG.			
5			X					
SLS AZMITH RUN								
11	XOVER SLS/SUM (AZ)	X			-15 TO 21			
8	SLS DEPTH OF NULL	X						
DIFFERANCE AZMITH RUN								
14	SYMMETRY OF DIFF. (AZ)	X			NOT > 1DB			
15			X					
12	NULL DEPTH (AZ)	X			28DB			
14	XOVER POINTS DIFF. (AZ) SUM (AZ)	X			2.5 TO3.5			
15								
14	NULL SUM/DIFF (AZ) @ XOVER	X			@LEAST 16			
15			X					
12	MAX S.L.(DIFF) (AZ)	X			24DB T1 22db RS1 6360,86			
13			X					
12	XPOL (DIFF) (AZ)	X			25DB			
13			X					

ATTACHMENT 4

PAGE NO. 1 OF 2

	ATCRBS2 ANT.	SR. #			DATE			
RUN #	DESCRIPTION	30	90	CHART #	STD	READING		REMARKS
	DIFFERENCE ELEVATION RUN							
3	DIFFERENCE MATCHES TEMPLET (EL)	X			TEMPLET			
[illegible]			X					
[illegible]	SUM MATCHES DIFF.	X			+/- 1DB FROM -1DEG TO +30 DEG			
/17			X					
16	SLOPE @ 0 DEG DIFF. (EL)	X			1.8 DB/DEG MINIMUM			
17			X					
16	SLOPE @ -2 DEG DIFF. (EL)	X			1.8 DB/DEG MINIMUM			
17			X					
16	ELEVATION ANGLE @ -16 DB POINT DIFF (EL)	X			0 TO -3.5 DEG.			
17			X					
	SUM ELEVATION							
	SLOPE @ ODEG EL (SUM)	X			1.8 DB/DEG			
			X					
	SLOPE @ -2 DEG	X			1.8 DB/DEG			
			X					
	ELEVATION ANGLE @ -16 DB POINT	X			0 TO 3.5 DEG			
			X					
		X						
			X					
[illegible]	SUM (EL) MATCHES TEMPLET	X			TEMPLET			
7			X					
10	SLS BACKFILL	X			-4 TO-8 DB			

ATTACHMENT 4

4. Antenna Pattern Test and Mechanical Data

ASR-8 Antenna

PN 822004

RAYTHEON
SERVICE COMPANY

TEST PROCEDURE
ASR-8 PATTERN AND MECHANICAL DATA

P/N 822004

PART OF FAA ASR-8

Use Data Sheets JR980901

SHEET NO.												
REV. STATUS												
SHEET NO.												
REV. STATUS												

ORIGINATOR: Joe Russum REVISED BY: QA APPR.:	ISSUE: ISSUE DATE: ORIG. DATE: ENGRG APPD:

RAYTHEON Drawing JR980901

1.0 Scope

This procedure is to be used to measure the ASR-8 antenna patterns and make physical measurements of the antenna. The pattern data taken for this test is printed out by the Antenna Analysis software with pass/fail indications. The printed patterns shall be attached to the data sheet drawing number JR980902 and become a part of the test data. Digital data shall be stored on floppy disk and retained in the antenna test range data library. The Antenna Analysis Software will also print out a pattern test check sheet. Any patterns that do not pass the required test shall be indicated as failing on the check sheet that is printed out by the pattern analysis program. The check sheet shall be signed by the operator and attached to the data sheet.

2.0 Equipment required:

Oklahoma City Antenna Test Range (See Antenna Test Range manual)

3.0 Reference Documents

Data Sheet, Test Procedure, ASR-8 JR980902

4.0 Set Up

4.1 Record the serial numbers of the antenna, dual feed assembly, telescope, and telescope bracket. (Record)

4.2 Install the ASR-8 antenna on the antenna test range per figure 1. The mixer should be as close to the dual feed assembly as practical, and there must be at least a 10dB pad between the mixer and the dual feed assembly. Mount the standard gain horn under the dual feed assembly. Connect the polarizer control box and verify that the polarizer is operating correctly. (Check)

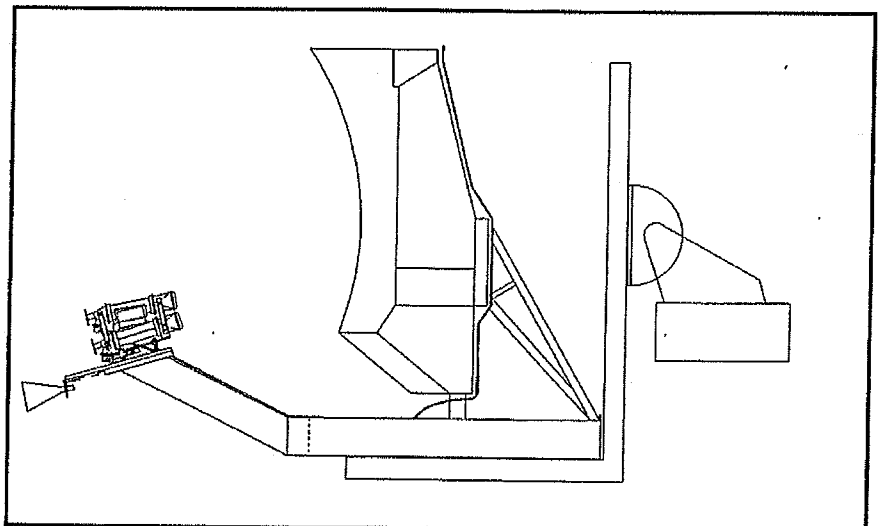

Figure 1 Test Configuration for ASR-8 Test

4.3 Check the nominal settings of the AAP Data Acquisition System. The settings listed below are nominal settings and can be adjusted for best operation of the antenna test range:

Mixer Current	0.6ma
FR	10 MHz (Search Bandwidth)
Bandwidth	2
Band	2 (200Hz)
Averaging Sample	3
AAP Record	Mid Scale
Interval	1/3 up from bottom

(Check)

4.4 Range Effects and pattern specifications relaxation To provide for measurement degradation caused by antenna test range interference, antenna aging, and other measurement problems, the antenna under test will be considered to pass if measured parameters meet the following requirements.

4.4.2 The sidelobe and cross polarized levels shall be considered to be within the specification limits if no more than two sidelobes and no more than 2 cross polarized components exceed the specified levels. Neither of the out of specification measurements shall be allowed to exceed the specified value by more than 1.0dB. Note on the data sheet indicate that the out of specification value is acceptable by circling the value and writing "Exception" by the value.

4.4.3 If the elevation beamwidth is less than 4.8 degrees an alternate measurement can be used. For this measurement determine how much the measured gain exceeds the required gain. This excess gain value is added to 3dB. The elevation beamwidth is then measured an a point that is 3dB plus the excess gain below the pattern peak of beam. The software will prompt the user to enter the excess gain and do the required calculations.

5.0 Detailed Test Procedure When ever the instructions are given to locate the peak of beam of the antenna under test, record on a scratch pad the pedestal settings so the point can be found at a later point in the test if this is a new pedestal setting.

5.1 Pattern Description

5.1.1 The patterns may be taken in any order; however, the following order is recommended:

Gain on both feeds

Note: All patterns required to calculate gain at the same frequency must be taken on the same day

Elevation patterns on both feeds

Note: All elevation patterns at the same frequency must be taken on the same day

All passive patterns

All active patterns

Note: All co-polarized and cross-polarized patterns of the same frequency must be done on the same day.

All circular polarized patterns

5.1.2 List of patterns Note that "A" is active and "P" is passive feed. "NS" is a dummy pattern name to allow the operator to record and plot any non specified pattern.

Pattern Number	Pattern Name	Pattern Number	Pattern Name
AGAIN	ACTIVE GAIN	18P	2.9 P AZ -6dB
PGAIN	PASSIVE GAIN	18PH	2.9 P XPOL -6dB
1S7	2.7 STD GAIN	19P	2.7 P AZ -15dB
1S8	2.8 STD GAIN	19PH	2.7 A XPOL -15dB
1S9	2.9 STD GAIN	20P	2.8 P AZ -15dB
2A	2.7 A ELEV	20PH	2.8 P XPOL -15dB
2P	2.7 P ELEV	21P	2.9 P AZ -15dB
3A	2.8 A ELEV	21PH	2.9 P XPOL -15dB
3P	2.8 P ELEV	25A	2.7 A AZ 10 DEG
4A	2.9 A ELEV	25P	2.7 P AZ 10 DEG
4P	2.9 P ELEV	26A	2.8 A AZ 10 DEG
12A	2.7 A AZ 0 DEG	26P	2.8 P AZ 10 DEG
12AH	2.7 A XPOL 0 DEG	27A	2.9 A AZ 10 DEG
13A	2.8 A 0 DEG	27P	2.9 P AZ 10 DEG
13AH	2.8 A XPOL 0 DEG	31A	2.7 A AZ 30 DEG
14A	2.9 A 0 DEG	32A	2.8 A AZ 30 DEG
14AH	2.9 A XPOL O DEG	33A	2.9 A AZ 30 DEG
12P	2.7 P AZ 0 DEG	31P	2.7 P AZ 28 DEG
12PH	2.7 P XPOL 0 DEG	32P	2.8 P AZ 28 DEG
13P	2.8 P AZ 0 DEG	33P	2.9 P AZ 28 DEG
13PH	2.8 P XPOL 0 DEG	34A	2.7 A ELEV ICR
14P	2.9 P AZ 0 DEG	35A	2.8 A ELEV ICR
14PH	2.9 P XPOL 0 DEG	36A	2.9 A ELEV ICR
16A	2.7 A AZ -6dB	34P	2.7 P ELEV ICR
16AH	2.7 A XPOL -6dB	35P	2.8 P ELEV ICR
17A	2.8 A AZ -6dB	36P	2.9 P ELEV ICR
17AH	2.8 A XPOL -6dB	37A	2.7 A AZ ICR
18A	2.9 A AZ -6dB	38A	2.8 A AZ ICR
18AH	2.9 A XPOL -6dB	39A	2.9 A AZ ICR
16P	2.7 P AZ -6dB	37P	2.7 P AZ ICR
16PH	2.7 P XPOL -6dB	38P	2.8 P AZ ICR
17P	2.8 P AZ -6dB	39P	2.9 P AZ ICR
17PH	2.8 P XPOL -6dB	NS	NO SPEC

5.2 Gain Patterns

5.2.1 With the range tuned to 2.7GHz, the antenna in the upright position, and the mixer connected to the standard gain horn, find the peak of beam of beam of the standard gain horn. Rotate the elevation turntable to move the standard gain horn down until the received power drops off at least 3dB. Start the elevation pedestal, moving the horn up and record a pattern from -3dB point to -3dB point on the other side of the POB. (Pattern 1S7)

5.2.2 Set the frequency to 2.8GHz and record a -3dB to -3dB pattern by rotating the horn down. (Pattern 1S8)

5.2.3 Set the frequency to 2.9GHz and cut another -3dB to -3dB pattern by rotating the horn up. (Pattern 1S9)

5.3 Azimuth Peak of Beam (Azimuth POB)

5.3.1 Move the mixer to the passive feed and locate the active pattern POB with he antenna in the upright position. Note the position of the pedestals.

5.3.2 Using the azimuth turntable rotate the antenna approximately 10degrees in one direction.

5.3.3 Rotate the azimuth turntable in the opposite direction and cut an azimuth pattern approximately 10 degrees on either side of the peak of beam. (Pattern 14P)

5.3.4 Change the frequency to 2.8GHz, and repeat 5.3.3. (Pattern 13P)

5.3.5 Change the frequency to 2.7GHz, and repeat 5.3.3. (Pattern 12P)

5.3.6 Rotate the azimuth pedestal to find the peak of beam. Rotate the source antenna 90 degrees or until the power level drops at least 30dB below the co-polarization power level. Back the antenna up approximately 1.5 Degrees.

5.3.7 Rotate the azimuth pedestal in the opposite direction to cut a pattern approximately 1.5 degrees on either side of the POB. (Pattern 12PH)

5.3.8 Change the frequency to 2.8 GHz, and repeat 5.3.6. (Pattern 13PH)

5.3.9 Change the frequency to 2.9 GHz and repeat 5.3.6. (Pattern 14PH)

5.3.10 Move the mixer to the active feed. Position the antenna to locate the active beam peak of beam. Note the position of the pedestals.

5.3.11 Cut a pattern, using the azimuth turntable, approximately 1.5 degrees on either side of the peak of beam. (Pattern 12AH)

5.3.12 Change the frequency to 2.8 GHz, and repeat 5.3.11. (Pattern 13AH)

5.3.13 Change the frequency to 2.7 GHz and repeat 5.3.11. (Pattern 14AH)

3.5.14 Run pattern analysis for the following:

AGAIN
PGAIN
12A COMBINED
13A COMBINED
14A COMBINED
12P COMBINED
13P COMBINED
14P COMBINED

5.4 Elevation Patterns

5.4.1 Using the roll axis, roll the antenna on its side. Locate the active peak of beam and note the position of the pedestals.

5.4.2 Rotate the azimuth pedestal to a point on the pattern approximately 25 degrees above the peak of beam on the CSC^2 pattern. Operate the roll axis to locate the peak power point at this point on the pattern. Note the roll axis setting.

5.4.3 Operate the azimuth pattern to the POB. Operate the azimuth and elevation pedestals to locate the POB. Note the pedestal settings. If either the elevation or azimuth pedestals are at different settings from the first peaking in paragraph 5.4.1, then repeat paragraph 5.4.2. Note the roll axis setting.

5.4.4 Back the azimuth pedestal in the direction of the ground side of the elevation pattern 10 degrees. Note the pedestal setting. This is elevation start point.

5.4.4 Operate the azimuth turntable and record a pattern to a point approximately 30 degrees above the POB. (Pattern 2A)

5.4.5 Change the frequency to 2.8 GHz, and record a pattern from this point to the elevation start point. (Pattern 3A)

5.4.6 Change the frequency to 2.9 GHz and record a pattern from this point to a point 30 degrees above the POB. (Pattern 4A)

5.4.7 Change the mixer to the passive feed and reposition the pedestal to the active POB. Record a pattern from the elevation start point to a print 30 degrees above the active pattern POB. (Pattern 4P)

5.4.8 Change the frequency to 2.8 GHz, and record a pattern from this point to the elevation start point. (Pattern 3P)

5.4.9 Change the frequency to 2.7 GHz and record a pattern from this point to a point 30 degrees above the POB. (Pattern 2P)

5.4.10 Run the analysis program for the following:

2A
2P
2A or 2P Combined
3A
3P
3A or 3P Combined
4A
4P
4A or 4P Combined

Note: All the required calculations are not done when the combined patterns are analyzed, so the non combined patterns must be analyzed before the combined patterns. To save time there is no need to print out the non combined patterns. The combined patterns contain all the data.

5.5 Ground side azimuth patterns
Azimuth patterns at the peak of beam were done for the gain calculation so those pattern need not be repeated.

5.5.1 Operate the roll axis to place the antenna in the upright position, the transmitter is still at 2.7 GHz and the detector on the passive feed.

5.5.2 Locate the peak of beam.

5.5.3 Operate the elevation turntable to raise the nose of the pattern until the pin drops 6dB. This is the local peak of beam for this pattern series.

5.5.4 Rotate the azimuth turntable 10 degrees and make an antenna pattern from 10 degrees from the POB to 10 degrees on the other side of the POB. (Pattern 16P)

5.5.5 Tune the transmitter to 2.8 GHz and repeat 5.5.4. (Pattern 17P)

5.5. 7 Tune the transmitter to 2.9GHz and repeat 5.5.4. (Pattern 18P)

5.5.6 Rotate the transmitter antenna to 90 degrees and record the cross polarized components that exist inside the main lobe using the azimuth turntable to cut a pattern 1.5 degrees on either side of the local POB. (Pattern 18HP)

Note: The easiest way to position the transmit antenna is to rotate the azimuth pedestal to the local peak of beam at the -6dB point and rotate the transmitter antenna to the lowest power point on the recorder. Satisfactory pattern can be cut almost all the time if this power point is at least -30dB relative to the local peak of beam.

5.5.7 Tune the transmitter to 2.8GHz. Record the cross polarization components that exist within the main co-polarization main lobe by operating the azimuth turntable to cut a pattern 1.5 degrees on either side of the local POB. (Pattern 17HP)

5.5.8 Tune the transmitter to 2.7GHz. Record the cross polarization components that exist within the main co-polarization main lobe using the azimuth turntable to cut a pattern 1.5 degrees on either side of the local POB. (Pattern 16HP)

5.5.9 Rotate the transmit antenna 90 degrees to the co-polarization position.

5.5.10 Operate the azimuth pattern to locate the local peak of beam. Operate the elevation turntable to raise the nose of the pattern until the pin drops 9dB more to a point -15dB below the elevation pattern peak of beam. This is the local peak of beam for this pattern series.

5.5.10 Rotate the azimuth turntable 10 degrees and make an antenna pattern from 10 degrees left to 10 degrees right of the local POB. (Pattern 19P)

5.5.11 Tune the transmitter to 2.8 GHz and repeat 5.5.10. (Pattern 20P)

5.5.12 Tune the transmitter to 2.9GHz and repeat 5.5.10. (Pattern 21P)

5.5.13 Rotate the transmitter antenna to 90 degrees and record the cross polarized components that exist inside the main lobe using the azimuth turntable. (Pattern 21HP)

5.5.14 Tune the transmitter to 2.8GHz. Record the cross polarization components that exist within the main co-polarization main lobe using the azimuth turntable. (Pattern 20HP)

5.5.15 Tune the transmitter to 2.7GHz. Record the cross polarization components that exist within the main co-polarization main lobe using the azimuth turntable. (Pattern 19HP)

5.5.16 Move the mixer to the active feed.

5.5.17 Locate the peak of beam.

5.5.18 Operate the elevation turntable to raise the nose of the pattern until the pin drops 6dB. This is the local peak of beam for this pattern series.

5.5.19 Rotate the azimuth turntable 10 degrees and make an antenna pattern from 10 degrees left to 10 degrees right of the beam center.
(Pattern 16A)

5.5.20 Tune the transmitter to 2.8 GHz and repeat 5.5.19. (Pattern 17A)

5.5. 21 Tune the transmitter to 2.9GHz and repeat 5.5.19. (Pattern 18A)

5.5.22 Rotate the transmitter antenna to 90 degrees and record the cross polarized components that exist inside the main lobe using the azimuth turntable.
(Pattern 18HA)

5.5.23 Tune the transmitter to 2.8GHz. Record the cross polarization components that exist within the main co-polarization main lobe using the azimuth turntable.
(Pattern 17HA)

5.5.24 Tune the transmitter to 2.7GHz. Record the cross polarization components that exist within the main co-polarization main lobe using the azimuth turntable.
(Pattern 16HA)

5.5.25 Run the following analysis:

16A	Combined
17A	Combined
18A	Combined
16P	Combined
17P	Combined
18P	Combined
19P	Combined
20P	Combined
21P	Combined

5.6 High elevation azimuth patterns

5.6.1 Rotate the transmit antenna to the co-polarization position.

5.6.2 With the mixer on the active feed and the transmitter tuned to 2.7GHz, operate the roll axis to rotate the antenna to the inverted position. Locate and note the peak of beam.

5.6.3 With the elevation turntable rotate the ASR-8 antenna up to a point 10 degrees above the peak of beam. This is the local peak of beam.

5.6.4 Cut a pattern using the azimuth turntable to cut a pattern from 10 degrees on one side of the local peak of beam to 10 degrees on the other side. (Pattern 25A)

5.6.5 Change the transmitter to 2.8GHz and cut a pattern 10 degrees on either side of the local peak of beam. (Pattern 26A)

5.6.6 Change the transmitter to 2.9GHz and cut a pattern 10 degrees on either side of the local peak of beam. (Pattern 27A)

5.6.7 Using the elevation turntable raise the antenna to a point 30 degrees above the peak of beam.

5.6.8 Cut a pattern using the azimuth turntable to cut a pattern from 10 degrees on one side of the local peak of beam to 10 degrees on the other side. (Pattern 33A)

5.6.9 Change the transmitter to 2.8GHz and cut a pattern 10 degrees on either side of the local peak of beam. (Pattern 32A)

5.6.10 Change the transmitter to 2.7GHz and cut a pattern 10 degrees on either side of the local peak of beam. (Pattern 31A)

5.6.11 Move the mixer to the passive feed and locate the peak of passive beam with the ASR-8 antenna in the inverted position. Note the pedestals position.

5.6.12 With the elevation turntable rotate the ASR-8 antenna up to a point 10 degrees above the peak of beam. This is the local peak of beam.

5.6.13 Cut a pattern using the azimuth turntable to cut a pattern from 10 degrees on one side of the local peak of beam to 10 degrees on the other side. (Pattern 25P)

5.6.14 Change the transmitter to 2.8GHz and cut a pattern 10 degrees on either side of the local peak of beam. (Pattern 26P)

5.6.15 Change the transmitter to 2.9GHz and cut a pattern 10 degrees on either side of the local peak of beam. (Pattern 27P)

5.6.16 Using the elevation turntable raise the antenna to a point 28 degrees above the peak of beam.

5.6.8 Cut a pattern using the azimuth turntable to cut a pattern from 10 degrees on one side of the local peak of beam to 10 degrees on the other side. (Pattern 33P)

5.6.9 Change the transmitter to 2.8GHz and cut a pattern 10 degrees on either side of the local peak of beam. (Pattern 32P)

5.6.10 Change the transmitter to 2.7GHz and cut a pattern 10 degrees on either side of the local peak of beam. (Pattern 31P)

5.7 Circular polarized patterns

5.7.1 With the roll pedestal, roll the ASR-8 antenna on its side. Rotate the transmitter antenna to the co-polarization position. Locate the passive peak of beam.

5.7.2 Rotate the azimuth pedestal to a point on the pattern approximately 25 degrees above the peak of beam on the CSC^2 pattern. Operate the roll axis to locate the peak power point at this point on the pattern. Note the roll axis setting.

5.7.3 Operate the azimuth pattern to the POB. Operate the azimuth and elevation pedestals to locate the POB. Note the pedestal settings. If either the elevation or azimuth pedestals are at different settings from the first peaking in paragraph 5.7.1, then repeat paragraph 5.7.2. Note the roll axis setting.

5.7.4 Start the transmitter antenna rotating at approximately 30 RPM, switch the ASR polarizer control to circular, and set the data taking on the AAP data screen to the highest level. Each pattern ripple should contain at least 7 data points.

5.7.5 Operate the azimuth pedestal in the direction of the ground side of the elevation pattern to a point at least 20dB below the peak of beam. This is elevation start point.

5.7.6 Operate the azimuth pattern and record a pattern to a point approximately 28 degrees above the POB. If the ripple shows sharp peaks then there are not enough points in each ripple. In this case, either speed up the data taking or slow the transmitter dish rotation. (Pattern 34P)

5.7.7 Change the transmitter frequency to 2.8GHz and record the pattern from 30 degrees to the start point. (Pattern 35P)

5.7.8 Change the transmitter frequency to 2.9GHz and record a pattern to a point approximately 28 degrees above the POB. (Pattern 36P)

5.7.9 Reposition the azimuth turntable to the peak of beam. Using the elevation axis point the ASR antenna down approximately 1 degree until the power drops at least 20dB. Record the azimuth ICR pattern by rotating the elevation axis up to a point on the other side of the POB that is at least 20dB below the peak power. (Pattern 39P)

5.7.10 Change the transmitter to 2.8GHz. Record a pattern by rotating the elevation pedestal down to the -20dB point on the other side of the POB. (Pattern 38P)

5.7.11 Change the transmitter to 2.7GHz. Record a pattern by rotating the elevation pedestal up to the -20dB point on the other side of the POB. (Pattern 37P)

5.7.12 Move the mixer to the active feed and reposition the pedestals to the readings of 5.7.3.

5.7.13 Locate the approximate POB of the active pattern.

5.7.14 Operate the azimuth pedestal in the direction of the ground side of the elevation pattern to a point at least 20dB below the peak of beam. This is elevation start point.

5.7.15 Operate the azimuth pattern and record a pattern to a point approximately 30 degrees above the POB. If the ripple shows sharp peaks then there are not enough points in each ripple. In this case, either speed up the data taking or slow the transmitter dish rotation. (Pattern 34A)

5.7.16 Change the transmitter frequency to 2.8GHz and record the pattern from 30 degrees to the start point. (Pattern 35A)

5.7.17 Change the transmitter frequency to 2.9GHz and record a pattern to a point approximately 30 degrees above the POB. (Pattern 36A)

5.7.18 Reposition the azimuth turntable to the peak of beam. Using the elevation axis point the ASR antenna down approximately 1 degree until the power drops at least 20dB. Record the azimuth ICR pattern by rotating the elevation axis up to a point on the other side of the POB that is at least 20dB below the peak power. (Pattern 39A)

5.7.19 Change the transmitter to 2.8GHz. Record a pattern by rotating the elevation pedestal down to the -20dB point on the other side of the POB. (Pattern 38A)

5.7.20 Change the transmitter to 2.7GHz. Record a pattern by rotating the elevation pedestal up to the -20dB point on the other side of the POB.
(Pattern 37A)

5.7.21 Analyze the following patterns:

34A	34P
35A	35P
36A	36P
37A	37P
38A	38P
39A	39P

5.8 Mechanical alignment of antenna.

5.8.1 Position the ASR antenna in the upright position.

5.8.2 Switch the polarizer to linear. Stop the transmitter antenna rotation and rotate it to co-polarized position.

5.8.3 With the transmitter at 2.7GHz, electrically peak the ASR active feed pattern in both azimuth and elevation planes.

5.8.4 Raise the antenna using the elevation turntable until the recorder pen drops 3 dB.

5.8.5 Record the synchro reading. (Record)

5.8.6 Change the transmitter frequency to 2.9 GHz and repeat 5.8.4 through 5.8.5.
(Record)

5.8.7 Change the transmitter frequency to 2.8 GHz and repeat 5.8.4 through 5.8.5.
(Record)

5.8.7 Rotate the antenna tilt using the elevation turntable until the elevation synchro reads the algebraic sum of the value recorded in 5.8.7 plus the range elevation (+0.1 degrees)

5.8.8 Place the precision level across the 4 level screws and adjust them until the level is level, set the level screws and lock in place using epoxy patch all around the head.
(Check)

5.8.9 Using a depth micrometer, measure the height of each pair of level screws at approximate center between screws. (Record)

5.8.10 Stand behind the Antenna Reflector in a position such that the pointer of the feed is in line with the center line of the transmitting antenna.

5.8.11 Install marker 453253-1 on the reflector at a point that is in line with the pointer on the feed and transmitting antenna feed. Secure marker. (Check)

5.8.14 On the data sheet, the synchro reading is labeled as A for 2.7 GHz, B for 2.8 GHz, and C for 2.9 GHz. Subtract A from B and record as 2.7 GHz beam tilt. Subtract C from B and record as 2.9 GHz beam tilt. (Record)

5.9 Reflector contour and feed location

5.9.1 Remove the antenna from the tower and position it on a flat section of ground.

5.9.2 Bolt the telescope on the active feed input waveguide, and by swinging the telescope through the three positions, locate and bolt targets to the reflector surface. When locating the telescope in each of the three detents, center the screw in the detent. Tighten the screw. Then loosen the screw one turn, and push the rear of the scope to the right. While holding he scope in this position, tighten the screw. Make the desired measurement after this procedure. Note If the targets are in place on the reflector and the cross hairs of the telescope align within the 0.50 inch circle, there is no need to replace the targets.

5.9.3 With the telescope on each target. Place a dent in the target at the cross hairs. Scribe a 0.5 inch circle around the dent.

5.9.4 Move the telescope to the mount on the edge of the reflector.

5.9.5 Tighten the telescope screw in each detent and site across the reflector.

5.9.6 Locate a pointed 48 inch scale in each detent on the indicated ribs to measure the distance from the rib to the line of site established on by the telescope. Move the scale up and down to locate the shortest distance from the rib to the telescope line of site. Then move the scale in a horizontal plane to locate the shortest point from the rib to the line of site. When the scale is positioned to read the shortest distance, take the reading and record on the chart on the data sheet. (Record)

6.0 If the antenna passes all test and all procedures are completed, sign and date the data sheet.

PERFORMANCE DATA REQUIREMENT

ASR-8 ANTENNA ASSEMBLY
822004-1
5985-01-204-1426

FA-9344

SN: ____________

Prepared by: ______________________ Date: __________
Approved by: ______________________ Date: __________
Tested by: ______________________ Date: __________
Inspected by: ______________________ Date: __________

SCREEN CONTOUR CHECK:

Check reflector curvature by checking contour measurements previously made at Texas Instruments. Fill in data table below with measured values.

Antenna Serial Numbers:

Reflector	822995-1	____________
Dual Feed Assembly	822008-1	____________
Test Antenna	822062-1	____________
Telescope	822147-1	____________
Telescope Bracket	510714-1	____________

ASR-8 ANTENNA PATTERN LIST

PATTERN	FREQUENCY (GHz) 2.7	2.8	2.9	ANTENNA POSITION	BEAM	CHART (DEG)	SCALE (dB)	DESCRIPTION
1A	X	X	X	UPRIGHT	A	60/360	40	GAIN, ACTIVE
1P	X	X	X	UPRIGHT	A	60/360	40	GAIN, PASSIVE
2	X			90 DEG	A&P	60	40	ELEVATION COMPOSITE
3		X		90 DEG	A&P	60	40	ELEVATION COMPOSITE
4			X	90 DEG	A&P	60	40	ELEVATION COMPOSITE
12A	X			90 DEG	A	10	40	AZIMUTH AT 0 DEG.
13A		X		90 DEG	A	10	40	AZIMUTH AT 0 DEG.
14A			X	90 DEG	A	10	40	AZIMUTH AT 0 DEG.
16A	X			90 DEG	A	10	40	AZIMUTH AT -6 dB
17A		X		90 DEG	A	10	40	AZIMUTH AT -6 dB
18A			X	90 DEG	A	10	40	AZIMUTH AT -6 dB
16P	X			90 DEG	P	10	40	AZIMUTH AT -6 dB
17P		X		90 DEG	P	10	40	AZIMUTH AT -6 dB
18P			X	90 DEG	P	10	40	AZIMUTH AT -6 dB
19P	X			90 DEG	P	10	40	AZIMUTH AT -15 dB
20P		X		90 DEG	P	10	40	AZIMUTH AT -15 dB
21P			X	90 DEG	P	10	40	AZIMUTH AT -15 dB
25A	X			90 DEG	A	10	40	AZIMUTH AT 10 DEG.
26A		X		90 DEG	A	10	40	AZIMUTH AT 10 DEG.
27A			X	90 DEG	A	10	40	AZIMUTH AT 10 DEG.
31A	X			90 DEG	A	10	40	AZIMUTH AT 30 DEG.
32A		X		90 DEG	A	10	40	AZIMUTH AT 30 DEG.
33A			X	90 DEG	A	10	40	AZIMUTH AT 30 DEG.
25P	X			90 DEG	P	10	40	AZIMUTH AT 10 DEG.
26P		X		90 DEG	P	10	40	AZIMUTH AT 10 DEG.
27P			X	90 DEG	P	10	40	AZIMUTH AT 10 DEG.
31P	X			90 DEG	P	10	40	AZIMUTH AT 28 DEG.
32P		X		90 DEG	P	10	40	AZIMUTH AT 28 DEG.
33P			X	90 DEG	P	10	40	AZIMUTH AT 28 DEG.
34A	X			90 DEG	A	10	40	ELEVATION ICR
35A		X		90 DEG	A	60	40	ELEVATION ICR
36A			X	90 DEG	A	60	40	ELEVATION ICR
34P	X			90 DEG	P	60	40	ELEVATION ICR
35P		X		90 DEG	P	60	40	ELEVATION ICR
36P			X	90 DEG	P	60	40	ELEVATION ICR
37A	X			90 DEG	A	10	40	AZIMUTH ICR
38A		X		90 DEG	A	10	40	AZIMUTH ICR
39A			X	90 DEG	A	10	40	AZIMUTH ICR
37P	X			90 DEG	P	10	40	AZIMUTH ICR
38P		X		90 DEG	P	10	40	AZIMUTH ICR
39P	Hx		X	90 DEG	P	10	40	AZIMUTH ICR

The antenna patterns are not required to be taken in any sequence except the antenna gain patterns 1A and 1P must be taken first. If these patterns meet specifications then the remaining patterns may be taken in any order.

In numbering the patterns, an "A" or "P" refers to the active or passive channel on the feedhorn that the pattern is to be taken on.

4.5 Antenna Gain - Pattern 1A

4.5.1 General:

This pattern tests the gain of the ASR-8 antenna. It compares the gain of the antenna to a known value of gain of a standard antenna. The difference in gain is used to calculate the actual gain of the ASR-8 antenna.

4.5.2 Range Effects

To provide for measurement degradation caused by antenna test range interferance and other measurement problem the antenna under test will be considered to pass the sidelobe and cross polarized compent level requirements if no more than two measurements of these parameters exceed the specified levels. Neither of the out of specification measurements shall be allowed to exceed the specified value by more than 1.0dB.

If any of the measured values exceed the allowed limits by less than 1dB check the "ALT( )" space by the space on the data sheet provided for the measured value. At the end of the test procedure record the total of out of limit values measured.

4.5.2.1 Connect the receiver input to the active feedhorn output using a WR-284 waveguide to coaxial adapter. There shall be a 10 dB pad attached directly to the waveguide to coax adapter for the test

4.5.2.1.2 Set the transmitter to 2.9 GHz and the transmitter antenna to vertical polarization.

4.5.2.1.3 Set the ASR antenna polarizer to LINEAR polarization.

4.5.2.1.4 Set the recorder to 60 deg. chart speed.

4.5.2.1.5 Peak the ASR antenna, using the positioner, in both the azimuth and elevation planes.

4.5.2.1.6 Make an approximate 2 dB azimuth beam width cut of the antenna with the peak in the 6 dB chart line.

4.5.2.1.7 Do not make any changes in the gain settings on the receiver for the remainder of this pattern.

4.5.2.1.8 Manually advance the chart approximately 2 inches.

4.5.2.1.9 Tune the transmitter to 2.8 GHz and make another 2 dB azimuth beam width cut of the antenna.

4.5.2.1.10 Manually advance the chart 2 inches.

4.5.2.1.11 Tune the transmitter to 2.7 GHz and make another 2 dB azimuth beam width cut of the ASR antenna.

4.5.2.1.12 Move the receiver WR-284 waveguide to coax adapter with its pad to the waveguide input of the "S" band standard gain horn.

4.5.2.1.13 Set the recorder chart speed to 360 deg. and adjust the azimuth and elevation positioners to the peak of the standard gain horn.

4.5.2.1.14 Manually return the chart until the pen is under the 2.7 GHz azimuth cut. Make an approximate 2 dB azimuth beam width cut on the standard gain horn.

4.5.2.1.15 Manually return the chart until the pen is under the 2.8 GHz azimuth beam width and repeat step 4.2.1.9

4.5.2.1.16 Manually advance the chart until the pen is under the 2.9 GHz cut, adjust the transmitter to 2.9 GHz, and make approximately a 2 dB azimuth cut of the standard gain horn.

4.5.2.1.17 Remove the chart, fill in the title block marking the pattern number 1A.

4.5.2.1.18 Measure the difference, in dB, of the ASR antenna and the standard gain horn for each frequency. As the standard gain horn is scanned through its peak of beam, ripples may be observed. The proper power level to befrecorded is half way between the maximum and minimum ripple of the peak of beam.

4.5.2.1.19 Add the values measured in 4.5.2.1.18 to the associated gains at the specified frequencies of the standard gain horn and record on the data sheet the gain of the antenna. (RECORD)

2.7 GHz - 17.30 dB
2.8 GHz - 17.58 dB
2.9 GHz - 17.82 dB

4.5.2.1.20 Disconnect the receiver from the active feedhorn and reconnect to the passive feedhorn of the ASR antenna.

4.5.2.1.21 Repeat steps 4.5 through 4.5.2.1.19.

4.5.2.1.22 Return the receiver input to the active feedhorn of the ASR antenna.

4.6 Elevation Composite Patterns (Active & Passive patterns on the same charts)

4.6.1 Roll antenna on its side and connect the receiver to the active feedhorn output.

4.6.2 Set the transmitter antenna to 90 deg. polarization and the ASR antenna polarizer to LINEAR polarization, and set the transmitter frequency to 2.7 GHz.

4.6.3 Set the chart scale to 60 deg.

4.6.4 Electrically peak the ASR antenna by peaking the peak of beam using the elevation axis and the null axis to peak the pattern at a point 25 degrees above the peak of beam.

4.6.5 Find the ASR peak of beam and set the recorder pen approximately on the 10 dB chart line.

4.6.6 Back up the positioner/recorder at least 15 deg from the peak of beam and make approximately a 50 deg. trace of the elevation pattern. Active feed tracing shall be solid lines and passive shall be dashed lines. This pattern is the linear tracing.

4.6.7 Do not remove the pattern from the recorder or lose the relationship of the pattern to the positioner. Make no recorder gain adjustments.

4.6.8 Change the ASR antenna polarizer to CIRCULAR polarization.

4.6.9 Back up the chart to approximately 3 deg. from the peak of beam, and make approximately a 6 deg. tracing through the peak of beam. This pattern is the C-P tracing.

4.6.10 Change the ASR antenna polarizer to LINEAR polarization. Do not remove the chart from the recorder. Make no gain adjustments. Note positioner azimuth position and turn off the chart drive.

4.6.11 Connect the receiver to the passive feedhorn on the ASR antenna.

4.6.12 Move azimuth turntable to the same position noted in 4.6.10

and turn on the chart drive.

4.6.13 Repeat steps 4.6.6 through 4.6.9.

4.6.14 Mark this pattern number 2 and change frequency to 2.8 GHz.

NOTE: Whenever pattern number is given, the chart shall be removed from the recorder and the title block filled in and the chart scale used shall be circled on each pattern.

4.6.15 Repeat 4.6.1 through 4.6.13.

4.6.16 Mark this pattern number 3 and change frequency to 2.9 GHz.

4.6.17 Repeat steps 4.6.1 through 4.6.13.

4.6.18 Mark this pattern number 4.

4.6.19 On patterns 2 through 4, connect a line (solid for active and dashed for passive) between the points listed below.

NOTE: All elevation pattern angles in this test procedure are measured in degrees relative to the peak of beam of the pattern (active or passive) in question.

Elevation Angle	dB Down from Peak of Beam
2.4	4
6	7
12	10.5
18	12
25	13
30 active (28 passive)	16

If each antenna pattern is coincident or above this line, the pattern meets its coverage requirements. Check data sheet. (CHECK)

4.6.20 Measure the half power beamwidth of all patterns. If the elevation beamwidth is less than 4.8 degrees an alternate measurement can be used. For this measurement determine how much the measured gain exceeds the required gain. This excess gain value is added to 3dB. The elevation beamwidth is then measured an a point that is 3dB plus the excess gain below the pattern peak. If the alternate method is used check the "ALT( )" space. (RECORD)

4.6.21 Measure the dB difference between the peak of beam level of the active and passive patterns. If the passive peak of beam power level is less than the active beam record as negative dB value. (RECORD)

4.6.22 Measure the active-passive beam separation by marking the ground side -3 dB point of each normal pattern. (Ground side of the elevation pattern is that side of the pattern having the most rapid power fall off(. Measure the dB difference between the active and passive pattern at the elevation angle of this -3 dB power point. (RECORD)

4.6.23 Measure the relative power level at a point 4.1 deg. (active) and 5.1 deg. (passive) below the ground side -3 dB point. If this level is down more than 20 dB below the peak of beam, record relative level on data sheet. (RECORD)

4.6.24 Measure the highest sidelobe level on the ground side of each elevation pattern. If it is down at least 22 dB on active pattern and 20 dB on passive pattern, record on data sheet. (RECORD)

4.6.25 Mark the displacement between the peak of beam of the C-P tracing and the linear tracing. If the displacement is less than .2 deg. record the displacement on the data sheet. (RECORD)

4.10 Azimuth Pattern, (Peak of Beam)

4.10.1 Set up the antenna upright with the receiver connected to the active feed.

4.10.2 Tune the transmitter to 2.7 GHz, the transmitter antenna polarization to 0 deg., and the ASR antenna polarizer to LINEAR polarization.

4.10.3 Electrically peak the ASR antenna in the azimuth and elevation plane.

4.10.4 Set the recorder to 10 deg. and set the recorder pen on the -10 dB line.

4.10.5 Back up the positioner 10 deg. and make an antenna pattern from 10 deg. left to 10 deg. right of the peak of beam.

4.10.6 Change the transmitter antenna to cross polarization and make a cross polarized pattern inside the main lobe. It is assumed in the rest of the test procedure that 90 deg. is the angle of the cross polarized component.

4.10.7 Change the transmitter antenna back to 0 deg. Polarization and the ASR antenna to CIRCULAR polarization.

4.10.8 Without changing the recorder gain setting make a pattern of the vertical component of the circular polarized pattern from approximately the 4 dB down point to the opposite 4dB down point on the other side of the peak of beam.

4.10.9 Note the azimuth position of the antenna and turn off the chart drive.

4.10.10 Move the receiver to the passive feed. Set the passive feed to LINEAR polarization.

4.10.11 Rotate the azimuth turntable to the same position noted in 4.10.9 and peak the pattern in elevation.

4.10.12 Reduce the recorder gain so the pen is approximately 5 dB below the circular polarized pattern.

4.10.13 Make a pattern of the passive peak of beam from approximately the 4 dB down point on one side of the peak to 4 dB down point on the other side.

4.10.14 Mark the pattern number 12A.

4.10.15 Change the receiver to the passive feed and repeat steps 4.10.3 through 4.10.8.

4.10.16 Mark this pattern number 12P.

4.10.17 Change the transmitter frequency to 2.8 GHz and the receiver to the active feedhorn.

4.10.18 Repeat steps 4.10.3 through 4.10.13 and mark the pattern 13A.

4.10.19 Repeat 4.10.15 and mark the pattern 13P

4.10.20 Change the transmitter frequency to 2.9 GHz and the receiver to the active feed.

4.10.21 Repeat 4.10.3 through 4.10.13 and mark the pattern number 14A.

4.10.22 Repeat 4.10.15 and mark the pattern number 14P.

4.10.23 Mark the center of the 3 dB beamwidths, 10 dB beamwidth, and 20 dB beamwidths. Using the 3 dB beam center of the linear vertical pattern as a reference determine that the beamshift of the 10 dB beam center is not more than .01 deg., the 20 dB beam center not more than .2 deg., the vertical component of the circular polarized pattern 3dB beam center not more than .1 deg., and the passive 3 dB beam center (patterns 12A, 13A, and 14A) not more than .15 deg. (RECORD)

4.10.24 Measure the 3 dB and 20 dB beamwidths and record. (RECORD)

4.10.25 Measure and record the peak sidelobe and cross polarized lobe level. (RECORD)

NOTE: In the event an azimuth pattern does not meet the requested specification when cut in the conventional manner, rotate the ASR-8 antenna to 90 deg. (on its side) and cut the pattern using the elevation axis. This pattern should be cut with the antenna pointing 1 degree below the transmitter rotating the ASR-8 antenna up using the elevation axis. The antenna will have to be rotated 180 deg. to cut the other side of the pattern. This pattern will be more accurate since the antenna gain is much lower in the direction of the ground.

4.12 Azimuth pattern below the elevation peak of beam. (ACTIVE)

4.12.1 With the receiver connected to the active feedhorn, tune the transmitter to 2.7 GHz, and peak the antenna in the elevation and azimuth planes.

4.12.2 Adjust the recorder gain so the pen is on the 0 dB line.

4.12.3 Raise the antenna in elevation until the pen drops 6 dB. (6 dB line)

4.12.4 Back up the azimuth positioner 10 deg. and make an antenna pattern from 10 deg. left to 10 deg right of the peak of beam.

4.12.5 Rotate the transmitter antenna to 90 deg and make a cross polarized pattern inside the main lobe of the vertically polarized pattern.

4.12.6 Rotate the transmitter antenna to 0 deg.

4.12.7 Mark this pattern as 16A.

4.12.8 Change the transmitter frequency to 2.8 GHz and repeat 4.12.2 through 4.12.6.

4.12.9 Mark this pattern as 17A.

4.12.10 Change the transmitter frequency to 2.9 GHz and repeat 4.12.2 through 4.12.6.

4.12.11 Mark this pattern as 18A.

4.12.12 Mark and record the following parameters:
- 3 dB beamwidth and beam center
- 10 dB beam center
- 17 dB beamwidth and beam center
- Peak sidelobe and cross polarized component level (RECORD)

4.12.13 Beam symmetry: If the angular difference between the 3 dB beamcenter and the 10 dB beamcenter is less than .1 deg and 3 dB to 17 dB beamcenter is less than .2 deg. record the angular difference on the data sheet. (RECORD)

4.13 Azimuth patterns below the elevation peak of beam (PASSIVE)

4.13.1 With the ASR antenna in the upright position, the transmitter on 2.9 GHz and the detector on the passive feed, peak the antenna in the azimuth and elevation plane.

4.13.2 Adjust the recorder gain so the pen is on the 0 dB line.

4.13.3 Operate the elevation turntable to raise the nose of the pattern until the pin drops to the -6dB line.

4.13.4 Rotate the azimuth turntable 10 deg. and make an antenna pattern from 10 deg. left to 10 deg. right of the beam center.

4.13.5 Rotate the transmitter antenna to 90 deg. and record the cross polarized components that exist inside the main lobe.

4.13.6 Rotate the transmitter antenna to 0 deg.

4.13.7 Record pattern as number 16P

4.13.8 Tune the transmitter to 2.8 GHz and repeat steps 4.13.4 through 4.13.6.

4.13.9 Record pattern as number 17P.

4.13.10 Tune the transmitter to 2.9 GHz and repeat steps 4.13.4 through 14.13.6.

4.13.11 Record pattern as number 18P.

4.13.12 Rotate the azimuth turntable and find the pattern peak.

4.13.13 Operate the elevation turntable until the nose of the pattern drops to the -15dB line.

4.13.14 Rotate the azimuth turntable 10 deg. and make an antenna pattern from 10 deg. left to 10 deg right of the beam center.

4.13.15 Rotate the transmitter antenna to 90 deg. and record the cross polarized components that exist inside the main lobe.

4.13.16 Record pattern as number 21P

4.13.17 Tune transmitter to 2.8 GHz and repeat steps 4.13.14 through 4.13.15.

4.13.18 Record pattern as number 20P.

4.13.19 Tune transmitter to 2.7 GHz and repeat steps 4.13.14 through 4.13.15.

4.13.20 Record pattern as number 19P.

4.14 Azimuth patterns in the CSC^2 portion of beam.

4.14.1 The transmitter antenna should be in the 0 deg. polarization position and the frequency tuned to 2.7 GHz. Set the chart recorder to 10 deg. per cycle.

4.14.2 Rotate the ASR-8 antenna to the inverted position.

4.14.2.1 Adjust the azimuth and elevation turntables to find the peak of beam for the active and passive beam. Note the elevation angle of each peak of beam on the control indicator and calculate the required indicator reading for points 10 and 30 degrees above the peak of beam for the active channel. Also calculate points 10 and 28 degrees above peak of beam for the passive channel.

4.14.3 Connect the receiver to the active feedhorn.

4.14.4 Move the elevation turntable to the +10 deg. pattern point.

4.14.5 Adjust the recorder gain so the pen is on the -10 dB line on the chart.

4.14.6 Back the azimuth turntable up 10 deg. and make a pattern from 10 deg. right to 10 deg. left of the peak of beam.

4.14.7 Rotate the transmitter antenna to 90 deg.

4.14.8 Make a pattern of the cross polarized component inside the main vertically polarized lobe.

4.14.9 Rotate the transmitter antenna to 0 deg. polarization.

4.14.10 Remove the chart and number the pattern 25A.

4.14.11 Tune the transmitter to 2.8 GHz and repeat steps 4.14.5 through 4.14.9.

4.14.12 Record this pattern as number 26A

4.14.13 Tune the transmitter to 2.9 GHz and repeat steps 4.14.5 through 4.14.9.

4.14.14 Record this pattern as number 27A.

4.14.15 Raise the elevation to the 30 deg. elevation point.

4.14.16 Tune the transmitter to 2.7 GHz and repeat steps 4.14.5 through 4.14.9.

4.14.17 Record this pattern as number 31A.

4.14.18 Tune the transmitter to 2.8 GHz and repeat steps 4.14.5 through 4.14.9.

4.14.19 Record this pattern as number 32A.

4.14.20 Tune the transmitter to 2.9 GHz and repeat steps 4.14.5 through 4.14.9.

4.14.21 Record this pattern as number 33A.

4.14.22 Switch the receiver to the passive feed on the ASR antenna.

4.14.23 Tune the transmitter to 2.7 GHz and move the elevation turntable to the position 10 degrees from the passive elevation peak of beam.

4.14.24 Repeat steps 4.14.5 through 4.14.9.

4.14.25 Record this pattern as number 25P.

4.14.26 Tune the transmitter to 2.8 GHz. and repeat steps 4.14.5 through 4.14.9.

4.14.27 Record this pattern as number 26P.

4.14.28 Tune the transmitter to 2.9 GHz and repeat steps 4.14.5 through 4.14.9.

4.14.29 Record this pattern as number 27P.

4.14.30 Tune the transmitter to 2.7 GHz and move the elevation turntable to the position 28 degrees from the passive elevation peak of beam.

4.14.31 Repeat steps 4.14.5 through 4.14.9.

4.14.32 Record this pattern as number 31P.

4.14.33 Tune the transmitter to 2.8 GHz and repeat steps 4.14.5 through 4.14.9.

4.14.34 Record this pattern as number 32P.

4.14.35 Tune the transmitter to 2.9 GHz and repeat steps 4.14.5 through 4.14.9.

4.14.36 Record this pattern as number 33P.

4.14.37 Mark the following on each pattern:
- -3dB beamwidth and beam center
- -10 dB beam center
- -17 dB beamwidth and beam center for the +10 and +20deg. patterns.
- -15 dB beamwidth and beam center for the +30 and +28 deg. patterns.
- Peak cross polarized component.
- Peak sidelobe level.

(RECORD)

4.14.38 Verify that the shift of the -10dB beam center relative to the -3dB beam center is less than .1 deg. and that the shift of -15dB or -17 dB beam center relative to the -3dB beam center is less than .2 deg. (RECORD)

4.15 Elevation radiation patterns - Integration cancellation ratio (ICR).

4.15.1 GENERAL INFORMATION

4.15.1.1 The ICR of the pattern is calculated using the following equation:

$$ICR = 10LOG_{10} [\text{Summation } (Pmax + Pmin)^2 / \text{Summation } (Pmax - Pmin)^2]$$

Values will be obtained from the elevation pattern every .5 deg. and every .17 deg. (1/6 degree) for the azimuth pattern.

4.15.1.2 When the ICR patterns meet requirements stated in paragraph 4.19, the ICR shall be estimated rather than calculated.

4.15.1.3 At each plane where measurements are required, patterns shall be made at three frequencies. Only the worst case ICR pattern of each three frequencies shall be used to calculate or estimate the ICR for each measured plane.

4.15.1.4 To measure the ICR pattern, the ASR Polarizer is set to circular polarization and the transmitter dish is rotated at a rate of .5 to 1 RPS. If the ICR pattern ripple exceeds 5 dB the transmitters dish shall be slowed to .25 to .5 RPS.

4.15.1.5 As in the case of the linear patterns, ICR patterns are required at the -6 dB, -15 dB, and -20 dB point on the ground side of the elevation peak of beam. These points shall be located by rotating the transmitting antenna to 0 deg. if the ASR antenna is in the upright position or 90 deg. if the ASR antenna is on its side: Find the peak of beam in elevation and azimuth, and rotate the ASR antenna up (if ASR antenna is on its side) to find the dB level desired. The ASR antenna shall be in circular polarization during the procedure.

4.15.1.7 All ICR patterns shall be made with the antenna on its side, unless the required pattern can not be made because of the limited elevation scan of the turntable. In that event, the pattern may be made with the antenna in the upright position.

4.15.2 Elevation ICR Pattern

4.15.2.1 An example of an elevation ICR pattern is shown in Figure 7.

4.15.2.2 Position the ASR antenna on its side and set the chart speed to 60 deg.

4.15.2.3 Connect the receiver to the active feed.

4.15.2.4 Set the transmitter to 2.7 GHz.

4.15.2.5 Locate the peak of beam by adjusting the elevation and azimuth turntables.

4.15.2.6 By operating the azimuth turntable, cut an elevation ICR pattern down to the -20 dB point and remove the chart from the recorder.

4.15.2.7 Number the patterns as indicated below:

PATTERN NO.	FREQUENCY (GHz)	FEEDHORN
34A	2.7	ACTIVE
34P	2.7	PASSIVE
35A	2.8	ACTIVE
35P	2.8	PASSIVE
36A	2.9	ACTIVE
36P	2.9	PASSIVE

4.15.2.8 Change the transmitter frequency to 2.8 GHz and repeat 4.15.2.6 and 4.15.2.7

4.15.2.9 Change the transmitter frequency to 2.9 GHz and repeat 4.15.2.6 and 4.15.2.7.

4.15.2.10 Connect the receiver to the passive feed and repeat 4.15.2.4 through 4.15.2.9.

4.15.2.11 Calculate or estimate the worst case active and the worst case passive ICR and record the ICR and frequency of that pattern. (RECORD)

4.15.3 Azimuth peak of Beam ICR

4.15.3.1 Connect the receiver to the passive feed.

4.15.3.2 Set the transmitter frequency to 2.7 GHz.

4.15.3.3 Set the chart speed to 10 deg.

4.15.3.4 Locate the peak of beam by adjusting the turntables in azimuth and elevation.

4.15.3.5 Locate the peak of beam by adjusting the turntables in azimuth and elevation.

4.15.3.5 By operating the elevation turntable, cut an azimuth ICR pattern down to the -20 dB point and remove the chart from the recorder.

4.15.3.6 Number the patterns as indicated below:

PATTERN NO.	FREQUENCY (GHz)	FEEDHORN
37A	2.7	ACTIVE
37P	2.7	PASSIVE
38A	2.8	ACTIVE
38P	2.8	PASSIVE
39A	2.9	ACTIVE
39P	2.9	PASSIVE

4.15.3.7 Change the transmitter frequency to 2.8 GHz and repeat 4.15.3.5.

4.15.3.8 Change the transmitter frequency to 2.9 GHz and repeat 4.15.3.5.

4.15.3.9 Move the detector to the active feed and repeat 4.15.3.4 through 4.15.3.8.

4.15.3.10 Calculate or estimate the worst case active and worst case passive ICR and record the ICR and frequency of that pattern. (RECORD)

4.16 Mechanical alignment of antenna.

4.16.1 Set up the antenna range as shown in Figure 1, with the detector mount connected to the Active feed horn output.

4.16.2 Set the transmitter antenna to propogate zero degree polarization, the transmitter frequency to 2.8 GHz and the ASR antenna polarizer to LINEAR position.

4.16.3 Electrically peak the ASR active feed patern in both azimuth and elevation planes.

4.16.4 Raise the antenna using the elevation turntable until the recorder pen drops 3 dB.

4.16.5 Record the synchro reading. (RECORD)

4.16.6 Rotate the antenna tilt using the elevation turntable until the elevation synchro reads the algebraic sum of the value recorded in 4.16.5 plus the range elevation (deg.)

4.16.6.1 Using the Starrett level, set the level screws and lock in place using epoxy patch all around the head. (CHECK)

4.16.6.2 Using a depth micrometer, measure the heighth of each pair of level screws at approximate center between screws. (CHECK)

4.16.7 Stand behind the Antenna Reflector in a position such that the pointer of the feed is in line with the center line of the transmitting antenna.

4.16.8 Install marker 453253-1 on the reflector at a point that is in line with the pointer on the feed and transmitting antenna. Secure marker. (CHECK)

4.16.9 Change the transmitter frequency to 2.7 GHz and repeat 4.16.3 through 4.16.5.

4.16.10 Change the transmitter frequenyc to 2.9 GHz and repeat 4.16.3 through 4.15.5.

4.16.11 On the data sheet, the synchro reading is labeled as A for 2.7 GHz, B for 2.8 GHz, and C for 2.9 GHz. Subtract A from B and record as 2.7 GHz beam tilt. Subtract C from B and record as 2.9 GHz beam tilt. (RECORD)

The following paragraphs are requested changes to this test procedure:

4.5.2 Range Effects

To provide for measurement degradation caused by antenna test range interferance and other measurement problem the antenna under test will be considered to pass the sidelobe and cross polarized compent level requirements if no more than two measurements of these parameters exceed the specified levels. Neither of the out of specification measurements shall be allowed to exceed the specified value by more than 1.0dB.

If any of the measured values exceed the allowed limits by less than 1dB check the "ALT( )" space by the space on the data sheet provided for the measured value. At the end of the test procedure record the total of out of limit values measured.

4.6.20 Measure the half power beamwidth of all patterns. If the elevation beamwidth is less than 4.8 degrees an alternate measurement can be used. For this measurement determine how much the measured gain exceeds the required gain. This excess gain value is added to 3dB. The elevation beamwidth is then measured an a point that is 3dB plus the excess gain below the pattern peak peak of beam. If the alternate method is used check the "ALT( )" space. (RECORD)